REPORT OF THE COUNCIL ON SCIENCE AND PUBLIC HEALTH

CSAPH Report 6-A-08

Subject: Portable Listening Devices and Noise-Induced Hearing Loss (Resolution 425, A-07)

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Referred to: Reference Committee D (Robert T. M. Phillips, MD, PhD, Chair)

Introduction

Resolution 425, introduced by the Michigan Delegation at the 2007 Annual Meeting and referred to the Board of Trustees, asks:

That our American Medical Association (AMA) support limiting the maximum output of portable musical devices to acceptable Occupational Safety & Health Administration (OSHA) guidelines; and

That our AMA lobby the federal government and/or appropriate federal agencies for the establishment of regulations or rules that would limit the output of portable musical devices sold in the United States to limits within OSHA guidelines.

Our AMA has long recognized the problem of noise-induced hearing loss. In 1990, a Board of Trustees report reviewed scientific data and concluded “…the misuse of personal headphones can pose a threat to the listener’s hearing. Such potential for harm depends upon a number of variables, including the station signal strength, battery strength, accuracy of volume settings, etc.” This report encouraged physicians to counsel patients about the potential loss of hearing associated with the misuse of personal listening devices; urged that research be directed at more specific definition of the relationship between acute and chronic use of personal listening devices and the occurrence of short-term and long-term noise-induced hearing loss; and directed the AMA to work with key stakeholders to enhance awareness, knowledge, and remediation of causes of noise-induced hearing loss (Policy H-440.957, AMA Policy Database).

Responding to continued concern about noise-induced hearing loss, the House of Delegates adopted Resolution 407 (I-00), which called on our AMA to encourage public education about the dangers of noise-induced hearing loss especially from toys and electronic devices, and encourage the Consumer Product Safety Commission and other federal agencies to study the impact of toys and electronic devices on noise-induced hearing loss among children and adolescents (Policy H-440.897).

Portable music players have continued to increase in popularity, and these listening devices have become smaller and more sophisticated. This report reviews the use of personal listening devices; the epidemiology of recreational, noise-induced hearing loss; current national guidelines for the maximum output of portable musical devices; and data on the decibel levels of in-ear headphones.
Methodology

Published studies from 1985 through February 2008 were identified by a MEDLINE search of English-language articles, using the search terms “noise induced hearing loss,” “acquired hearing loss,” “headphones,” “in-ear headphones,” and “portable listening devices.” A total of 14 articles were identified; additional articles were identified by review of references cited in these publications. In addition, web sites of OSHA, the National Institute of Occupational Safety and Health (NIOSH), and the National Institute on Deafness and Other Communication Disorders were searched for information relevant to noise-induced hearing loss. Reports from the National Institutes of Health Consensus Development Conference on Noise and Hearing Loss and from the American Speech-Language-Hearing Association also were consulted. Consultation with national experts and key stakeholder organizations provided additional perspective.

Use of Personal Listening Devices

Rapid technological advances have revolutionized personal listening devices, leading to an electronics market dominated by Walkman, iPod, and other brands of MP3 players. A 2006 national study of 1000 individuals aged 18 to 70 years conducted on behalf of the American Speech-Language-Hearing Association provides information on the contemporary listening habits of youth and adults.1 This study found that approximately 36% of adults and 62% of students used Walkman personal electronic listening devices, 11% and 36% respectively used iPod devices, and 11% and 25% respectively used other brands of MP3 players (Table). Hispanic and African Americans were more likely than Caucasians to report using each of the listening devices. Use rose with family income, and declined with age. Regardless of the type of portable musical device, the typical listening session lasted from 1 to 4 hours for approximately 40% of adults and 25% to 30% of youth. In addition, approximately 35% of adults and 40% to 59% of teens reported listening at loud volumes.

Table: Listening Practices with Portable Musical Devices

<table>
<thead>
<tr>
<th>Usage of Devices</th>
<th>Length of Typical Session: 1-4 hrs</th>
<th>Usual Volume: Loud</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult</td>
<td>Student</td>
<td>Adult</td>
</tr>
<tr>
<td>Walkman*</td>
<td>36%</td>
<td>37%</td>
</tr>
<tr>
<td>Apple iPod</td>
<td>11%</td>
<td>38%</td>
</tr>
<tr>
<td>Other MP3 player</td>
<td>11%</td>
<td>43%</td>
</tr>
</tbody>
</table>

*portable CD player

The Relationship between Personal Listening Devices and Hearing Loss

The intensity, frequency, and duration of noise exposure affect hearing loss.2 OSHA regulations, promulgated in 1983, set the industrial standard for permissible noise exposure levels at 4 hours for 95 decibels, 2 hours for 100 decibels, and 1 hour for 105 decibels.3 When employees are subjected to sound exceeding these levels, feasible administrative or engineering controls should be utilized. If such controls fail to reduce sound levels within OSHA limits, personal protective equipment must be provided and used to reduce sound levels within the noise exposure standards. When information indicates that any employee's exposure may equal or exceed an 8-hour time-weighted average of 85 decibels, employers should develop and implement a monitoring program.
as part of a “hearing conservation program,” and make audiometric testing available to all employees whose exposures equal or exceed such limits.

In 1998, NIOSH updated its previous 1972 recommendations on permissible sound level in order to focus on preventing hearing loss, not merely conserving hearing. Similar to OSHA, NIOSH recommends a “hearing loss prevention program” for workers whose noise exposures equal or exceed 85 decibels for 8 hours, that includes exposure assessment, engineering and administrative controls, proper use of hearing protectors, audiometric evaluation, education and motivation, recordkeeping, and program audits and evaluations. Additionally, NIOSH recommends that occupational noise exposure be controlled at certain levels based on the combination of exposure level ($L$) and duration ($T$), according a formula that is more stringent based on the requirement that noise exposure time be halved for each 3-decibel increase in noise level. Consequently, the most recent NIOSH recommendations are more stringent than OSHA’s as the noise level increases.\(^4\) It should be noted, however, that occupational noise levels average the intensity and reflect a steady-state of continuous high level noise; when daily noise exposure consists of periods of different noise levels, these can also be converted to a time-weighted average. In contrast to industrial noise, music has wide ranges of frequency as well as intensity and does not reflect a continuous state.

Although individual preferences for music loudness are subjective, portable music devices are capable of producing decibel levels that exceed occupational safety limits. According to the American Speech-Language-Hearing Association, at maximum volume, Apple iPods produce sound at 120 to 125 decibels, the Sony Walkman MP3 player at 108 to 115 decibels, and the Bratz-Liptunes MP3 player at 115 to 120 decibels.\(^5\) Portnuff and Fligor studied the loudness produced at different volume settings.\(^6\) Averaging the results from different types of earphones, a volume control of 50% produced sound at approximately 70 decibels, of 70% at approximately 80 decibels, and of 100% at approximately 100 decibels. On average, the output level of in-ear headphones was 5.5 decibels higher than over-the-ear headphones.

Although portable music devices and attendant headphones have the potential to cause hearing damage, actual effects are probably short-lived. After exposure to a loud noise of either long duration and low intensity or high intensity and short duration, a person may have a temporary threshold shift in hearing, which is an immediate hearing loss sometimes accompanied by ringing in the ears (tinnitus). Usually, the cochlea will recover over a period of a few days. If the duration and intensity are too great, however, permanent hearing loss might occur. The results of a number of studies suggest that 5% to 20% of people who use portable music devices with over-the-ear headphones experience either tinnitus or dull hearing.\(^9\)-\(^12\) It is difficult, however, to extrapolate these results to current patterns of use, because these studies were conducted before the most recent advances in earphone technology. The results of epidemiological studies from both the United States and Argentina suggest, in fact, that no correlation exists between the use of portable music devices and hearing deficits.\(^9,13\) Furthermore, there are no studies on the long-term effects of portable music devices, regardless of the type of earphones used.

At least six factors complicate the design and interpretation of studies on portable music devices and noise-induced hearing loss: (1) OSHA standards are based on using occupational noise in calculating hearing loss; however, compared with occupational noise, music varies in acoustic spectrum and intensity; (2) musical sounds reaching the inner ear are discontinuous, thus providing the hair cells an opportunity for some recovery; (3) listening devices vary in their output capacity; (4) headphones vary in terms of the distance at which they deliver sound to the ear canal; (5) users vary the actual listening volume according to environmental noise and the noise reduction capability of the headphone; and (6) individuals vary in their sensitivity to
damage and recovery from noise.\textsuperscript{9,12,14,15} More research is needed to increase basic understanding of the physiology of hearing loss from in-ear headphones, the relationship of noise-induced hearing loss to age, and recovery expectations.

Technological advances in headphones have created smaller and more efficient devices for delivering music. More efficient blocking of ambient noise translates to a lower volume used when listening to music.\textsuperscript{14} Whereas 20 years ago headphones were relatively bulky, most MP3 players today are sold with in-ear headphones.\textsuperscript{14} These devices do not block as much ambient noise as over-the-ear devices, and they also deliver sound more directly to the ear canal. Thus, independent of the type of portable music device, in-ear headphones produce noise levels in the ear canal that are substantially greater than noise levels of over-the-ear headphones at the same volume control setting.\textsuperscript{15} For example, in a laboratory study on 100 young adults, Fligor and Ives demonstrated that the preferred listening level of most subjects using different in-ear headphones was around 65 decibels in low background noise (range 63 to 67), and 83 decibels with high background noise (range 77 to 89).\textsuperscript{16} Two earphones used in this study had built-in ambient noise isolation. When using earphones with this technology, the preferred listening decibel level was lower than with the use of non-dampened earphones (77 and 84 decibels vs. 89 decibels).

Summary and Discussion

Theoretically, current portable music devices produce maximum sound levels that can damage hearing and lead to hearing loss. In addition, in-ear headphones produce sound at substantially greater levels than do over-the-ear models. It is not clear, however, if the combination of high-output portable music devices and in-ear headphones causes long-term hearing loss. Although some laboratory and epidemiological data suggest a link between temporary noise-induced hearing loss and listening devices, this relationship is not as well established for in-ear headphones. The rising popularity of portable music devices and in-ear headphones, however, raises the question of how to address the potential public health risk of noise-induced hearing loss. Three potential approaches are:

1. Promote a health education message to alert users that listening to music at high volume and for long durations may damage hearing. Various public and private organizations could work to educate the public on the potential hazard of listening to loud music. Although national guidelines do not exist, a set of recommendations based on scientific information for maximum listening times per day for in-ear headphones to prevent noise-induced hearing loss risk criteria has been proposed.\textsuperscript{6} Thus, when the volume control on the music device is ≤ 60%, there is no limitation for the length of an individual listening session. However, with the volume at 70%, a person should not listen for more than 6 hours, at 80% not more than 1.5 hours, at 90% not more than 22 minutes, and at 100% not more than 5 minutes.

2. Advocate for expansion and use of technology to reduce earphone-delivered sound. At least four technologies reduce the potential damage. Noise isolation devices work like earplugs to block background noise, thus enabling a person to listen comfortably at lower volumes even in loud environments. Noise cancellation headphones, by comparison, are bulkier and employ an active technology that is run by batteries. The sound isolation devices are relatively expensive ($40 to $100). Finally, automatic volume limiter systems are built into some portable listening devices and permit the user to set a maximum volume control. Two companies currently produce products with this technology.
3. Advocate for health protection legislation. This option raises the issue of whether or not the government should mandate that manufacturers of portable music devices should limit the maximum sound their devices can emit. When deciding if government intervention to reduce public health risks is warranted, it is important to consider the scientific evidence on the nature of the problem, as well as the feasibility and cost of potential solutions. Although there is no doubt that portable music devices produce sound that can damage hearing, epidemiological data on the extent of noise-induced hearing loss caused by in-ear headphones are lacking. Furthermore, as discussed above, companies are already producing earphones and music devices that permit a person to voluntarily limit the sound output.

Given all of these considerations, invoking a mandate to limit sound emission from portable music devices appears unwarranted and unnecessary at this time, and the most expedient approach is to promote a health education message. Therefore, the Council believes that existing AMA policy is adequate.

RECOMMENDATION

The Council on Science and Public Health recommends that the following statement be adopted in lieu of Resolution 425 (A-07) and the remainder of the report be filed:


(Reaffirm HOD Policy)

Fiscal Note: None
References


